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RADIOMETRIC SORTING OF AN URANIUM ORE SAMPLE FROM STANLEIGH MINE - RIO ALGOM

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RADIOMETRIC SORTING OF AN URANIUM ORE SAMPLE FROM STANLEIGH MINE - RIO ALGOM

by

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ABSTRACT

An ore sample of about 0.07% U_3O_8 from Stanleigh Mine - Elliot Lake was subjected to radiometric sorting by Ore Sorters Limited. Although only 56 % of the sample weight fell within the sortable size range (-150 to 20 mm) the overall results of the sorting were quite good. At 1.24 counts/cm^2 (8 counts/$inch^2$) a substantial amount of material, approximately 28%, by weight, of the entire sample was removed as a low uranium tailing (0.015% U_3O_8), for an uranium loss of 6%.

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TRIAGE RADIOMÉTRIQUE D'UN ÉCHANTILLON DE MINERAI D'URANIUM PROVENANT DE LA MINE STANLEIGH - RIO ALGOM

par

M.A. Cristovici*

RÉSUMÉ

Un échantillon de minerai titrant environ 0,07 % U_3O_8, en provenance de la mine Stanleigh à Elliot Lake, a été soumis à un triage radiométrique par la société Ore Sorters Limited. Bien que 56 % seulement du poids de l'échantillon se situait dans la classe granulométrique propre au triage (-150 + 20 mm), les résultats du triage ont été, en général, satisfaisants. Au taux de 1,24 comptes par cm^2 (8 comptes par pouce carré), une quantité importante de matériaux, soit environ 28 % (par poids) de l'échantillon, a été rejetée comme résidu d'uranium (0,015 % U_3O_8), ce qui constitue une perte d'uranium de 6 %.

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INTRODUCTION

Separation of the radioactive ore from the associated inert material prior to leaching has become increasingly important for the economics of low grade uranium ore process.

Some years ago CANMET has developed a preconcentration technique applied to low content uranium ores in Elliot Lake area, which consisted in pyrite flotation and magnetic separation of the radionucleides. By this process approximately two thirds of the ore, by weight, can be discarded before leaching, as low radioactive tailing.

In an effort to eliminate even more waste from the leaching process, CANMET has reactivated the interest in the radiometric sorting of low grade uranium ore. In 1983 an ore sample from Quirke Mine - Rio Algom in Elliot Lake was examined by Ore Sorters Limited for possible preconcentration by radiometric sorting (1). The results did not show sufficient economic advantage to warrant the continuation of the sorting trials on this ore. However, when Stanleigh Mine of Rio Algom went into production renewed interest was shown for radiometric sorting of this ore.

Arrangements were then made to have Rio Algom collect a sample from Stanleigh ore and Ore Sorters Limited in Peterborough run the radiometric sorting experiments.

This report covers the results of the sorting trials conducted by Ore Sorters Limited on a uranium ore sample supplied by Rio Algom Limited from their Stanleigh Mine operation in Elliot Lake, Ontario.

The chemical assay of the products obtained from sorting were performed in Rio Algom, Elliot Lake laboratories. The calculation and interpretation of the results as well as the preparation of the report was part of the CANMET contribution to this project. It is believed that the uranium producers in Canada could benefit from the findings of this testwork.

TESTWORK

The testwork to examine the possibility of preconcentrating the ore sample from Stanleigh Mine by radiometric sorting was carried out by Ore Sorters Limited of Peterborough.

ORE SAMPLE

Seven drums containing about 1.5 tonnes of uranium ore crushed to -150 mm were received by Ore Sorters from Rio Algom, Stanleigh Mine for radiometric sorting.

1. Head assay

The head assay of the uranium sample was back calculated using the assay results of the testwork products. The calculated uranium content of the sample was 0.067 % U_3O_8.

2. Sample preparation

The ore was passed through a 20 mm screen and the -20 mm fraction was removed since this material was too fine to be processed by radiometric sorting.

The +20 mm ore was classified into three fractions: -150 +100; -100 +50 mm and -50 +20 mm. Each fraction was separately subjected to radiometric sorting.

The weight distribution of the screening products is given in Table 1.

Table 1 - Weight distribution of the screening products

Fractions size, mm	Weight kg	Weight %
-150 +100	134	8.5
-100 +50	328	20.7
-50 +20	423	26.7
-20	698	44.1
Head	1583	100.0

A high proportion of material (44.1%) fell in the -20 mm fraction, outside of the sortable range.

EXPERIMENTS

Model 17 Sorter was used to test the response of the ore sample to radiometric sorting. The description of the equipment and the principle of operation was given in a previous report (1).

1. Conditions

Each of the sortable fractions (+100, +50 and +20 mm) was separately passed through the sorter whose game-detection system was programmed to select at three levels of counts per unit area.

At each cut-off level two products were obtained: the accept and the reject, whose radioactive readings were respectively higher and lower than the pre-selected setting.

The ore was first sorted against a cut-off level of 0.62 counts/cm^2 (4 counts/$inch^2$) when Accept-1 and Reject-1 were obtained. The reject was saved and the accept was resorted under 1.24 count/cm^2(8 counts/$inch^2$).

The resulting products were Reject-2 which was saved and Accept-2 which was finally retreated against a preselected cut-off level of 2.48 counts/cm^2 (16 counts/$inch^2$). Accept-3 and Reject-3 were the products of the last sorting stage.

All the final products: Reject -1 to -3 and Accept -3 were weighed and assayed for uranium content.

2. Results

The results of the sorting trials are presented in Table 2. The table firstly shows the weight as well as the uranium assay and distribution of all products resulting from the radiometric sorting. Also the weight and uranium assay of the Fines product (-20 mm fraction) removed by classification prior to sorting are included in the table.

Then, based on calculated data, the following three sorting options were evaluated and presented on the lower part of the table.

a) Sorting the ore against a cut-off level of 0.62 counts/cm^2 (4 counts/$inch^2$).

Under this condition the combined Rejects-1 resulting from separate treatment of each sortable fraction, represented 16.3% by weight of the original ore sample, for an uranium content of 0.011% U_3O_8 and a uranium loss of 2.7%.

The uranium lost in the rejects is definitely very low, however, the weight reduction to the material left for further processing (Accepts -1 and Fines) is considered insufficient to justify, in this case, the cost of the radiometric preconcentration.

b) Sorting the ore against a cut-off level of 1.2 4 counts/cm^2 (8 counts/$inch^2$).

The combined Rejects 1 and 2 pertaining to this sorting condition represented a weight of 27.8% related to the total sample at a content of 0.015% U_3O_8 and an overall uranium loss of approximately 6%.

The weight reduction to the material sorted for further treatment was this time quite substantial, without a too drastic loss of uranium in the combined rejects.

c) Sorting the ore against a cut-off level of 2.48 counts/cm^2 (16 counts/$inch^2$).

Radiometric preconcentration under this condition lead to a total weight removal of 36.6%. The combined rejects contained 0.02% U_3O_8 representing an overall uranium loss of 10.7%.

Obviously the amount of material removed was even higher at this cut-off, however, the uranium lost in the rejects was considered unacceptable high.

Table 2 - Results of the radiometric sorting of Stanleigh Mine (Rio Algom) ore sample

Size mm	Product	Counts per cm^2	Counts per in^2	% Weight Ind	% Weight C/A	Assay, U_3O_8 lb/st	Assay, U_3O_8 %	% Dist. U_3O_8 Ind	% Dist. U_3O_8 C/A
	Reject-1	0.62	4	26.3	2.3	0.41	0.021	11.1	0.7
	Reject-2	1.24	8	17.8	1.5	0.40	0.020	7.2	0.5
-150 +100	Reject-3	2.48	16	16.9	1.4	0.78	0.039	13.3	0.8
	Accept-3	2.48	16	39.0	3.3	1.74	0.087	68.4	4.3
	Head (calc)			100.0	8.5		0.050	100.0	6.3
	Reject-1	0.62	4	31.1	6.4	0.09	0.005	3.3	0.5
	Reject-2	1.24	8	23.1	4.8	0.44	0.022	10.9	1.6
-100 +50	Reject-3	2.48	16	18.9	3.9	0.65	0.033	13.3	1.9
	Accept-3	2.48	16	26.9	5.6	2.52	0.126	72.5	10.5
	Head (calc)			100.0	20.7		0.047	100.0	14.5
	Reject-1	0.62	4	28.5	7.6	0.26	0.013	6.6	1.5
	Reject-2	1.24	8	19.5	5.2	0.39	0.020	6.9	1.5
-50 +20	Reject-3	2.48	16	13.0	3.5	0.65	0.033	7.6	1.7
	Accept-3	2.48	16	39.0	10.4	2.28	0.114	78.9	17.5
	Head (calc)			100.0	26.7		0.056	100.0	22.2
-20	Fines (assay)				44.1	1.73	0.087	-	57.0
	Sample Head (calc)				100.0		0.067		100.0
Combined -20mm and Accepts 1		0.62	4		83.7		0.078		97.3
Rejects 1		-0.62	-4		16.3		0.011		2.7
Combined -20mm and Accepts 2		1.24	8		72.2		0.087		93.8
Rejects 1 + 2		-1.24	-8		27.8		0.015		6.2
Combined -20mm and Accepts 3		2.48	16		63.4		0.095		89.3
Rejects 1 + 2 + 3		-2.48	-16		36.6		0.020		10.7

CONCLUSIONS

The results of the testwork performed by Ore Sorters on an ore sample of approximately 0.7% U_3O_8 from Stanleigh Mine - Elliot Lake showed good response of the material to radiometric sorting.

Although, only 55.9% by weight of the ore sample fell within the sortable range, the rejects of the radiometric sorting at 1.24 counts/cm^2 (8 counts/$inch^2$) represented a substantial weight removal (50.3% related to sorting feed or 27.8% to original sample) for an uranium loss of 6.2%. It might be possible to reduce the uranium loss by increasing the amount of material falling in the sortable range. For that it will be probably required to adjust the mining conditions and the primary crushing to reduce as much as possible the production of fines.

REFERENCE

1. M.A. Cristovici, "Radioactive sorting of Rio Algom uranium ore"; Division Report MRP/MSL 83-51(IR); CANMET, Energy, Mines and Resources; 1983.

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